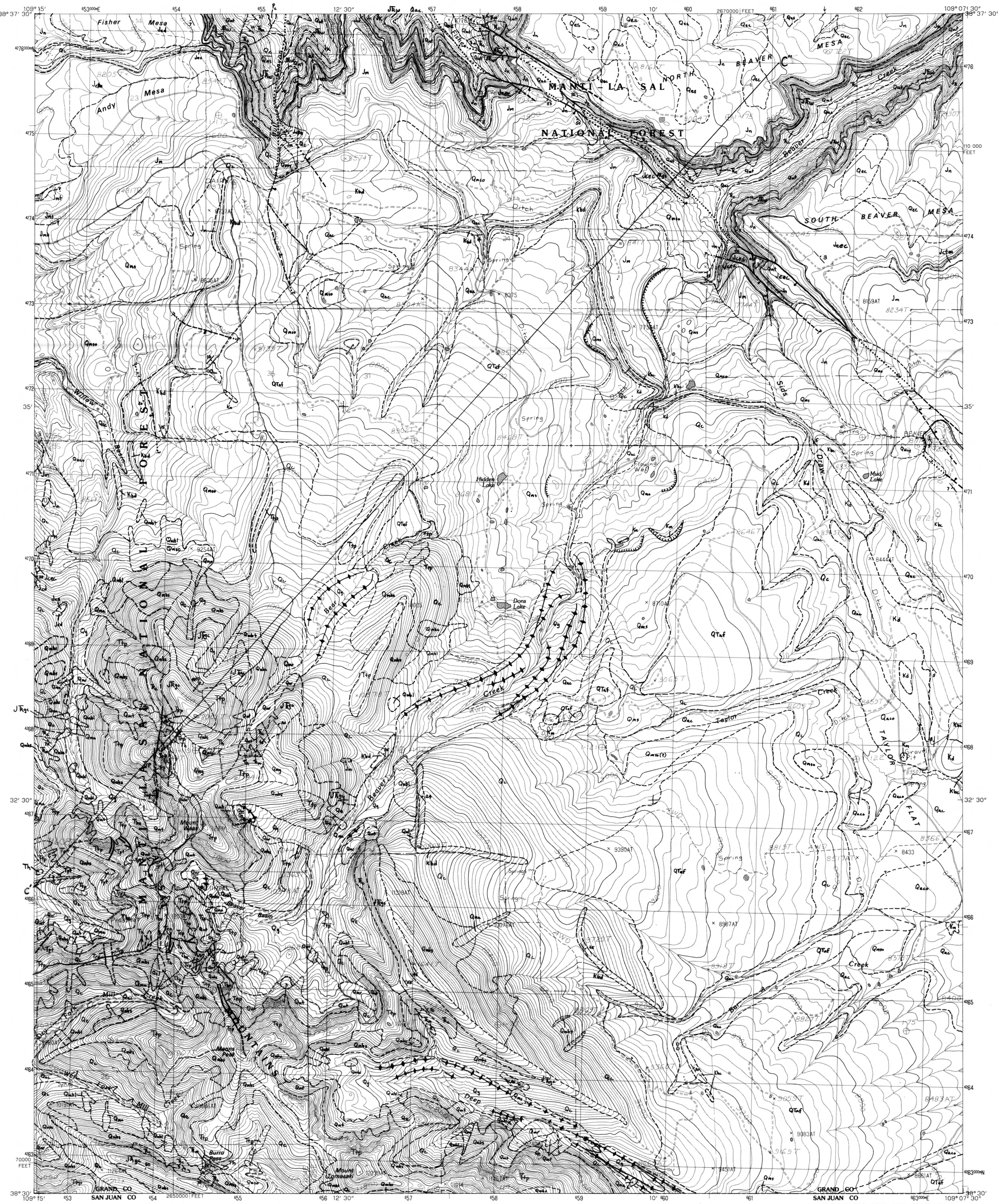
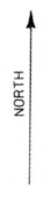
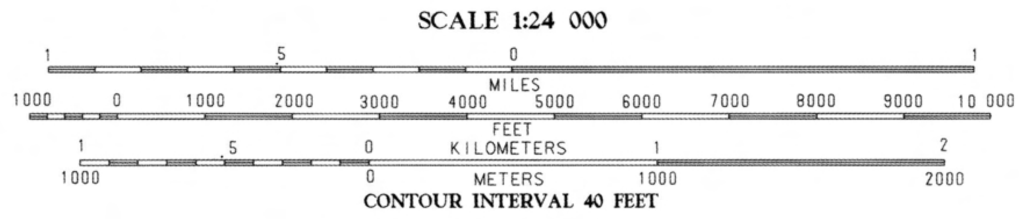
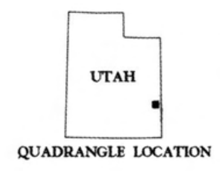
UTAH GEOLOGICAL SURVEY
a division of
Utah Department of Natural Resources









QUADRANGLE LOCATION

Project manager: Douglas A. Sprinkel
Field mapping by author: 1990-1995

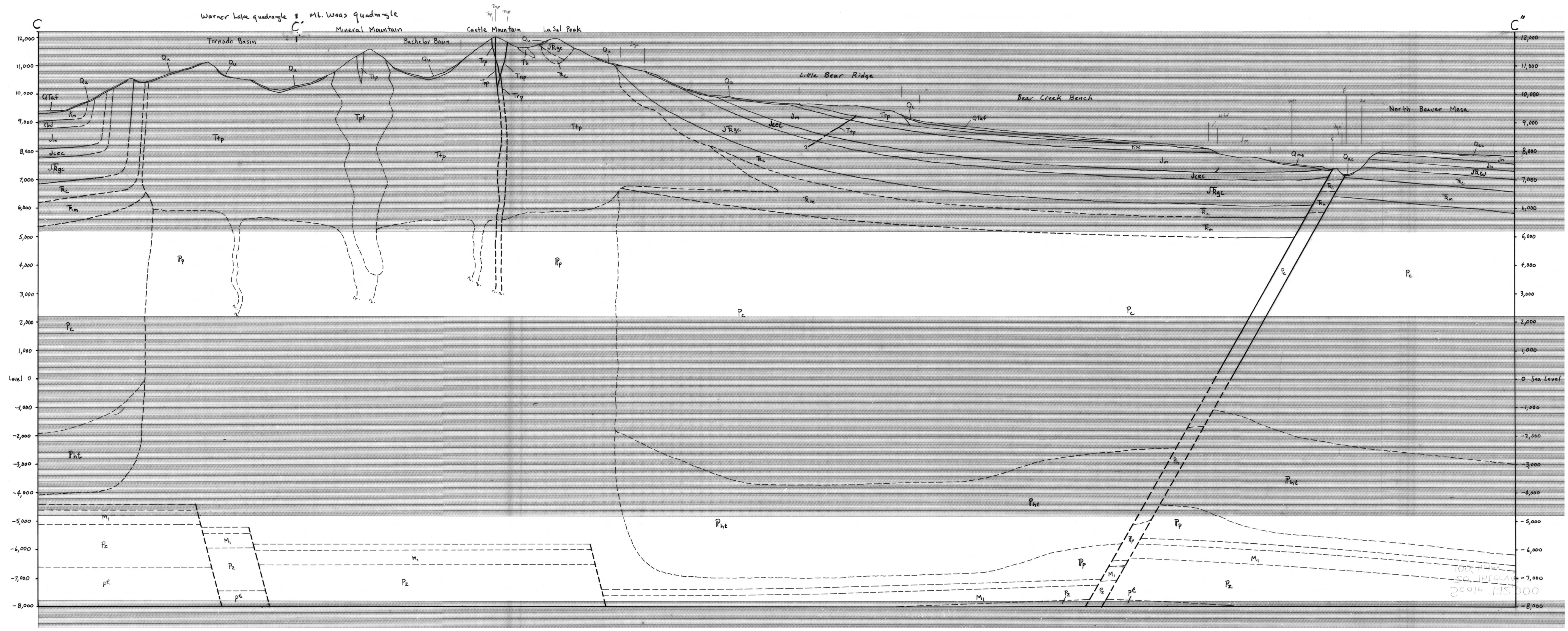
Preliminary Geologic Map of the Mount Waas Quadrangle, Grand County, Utah

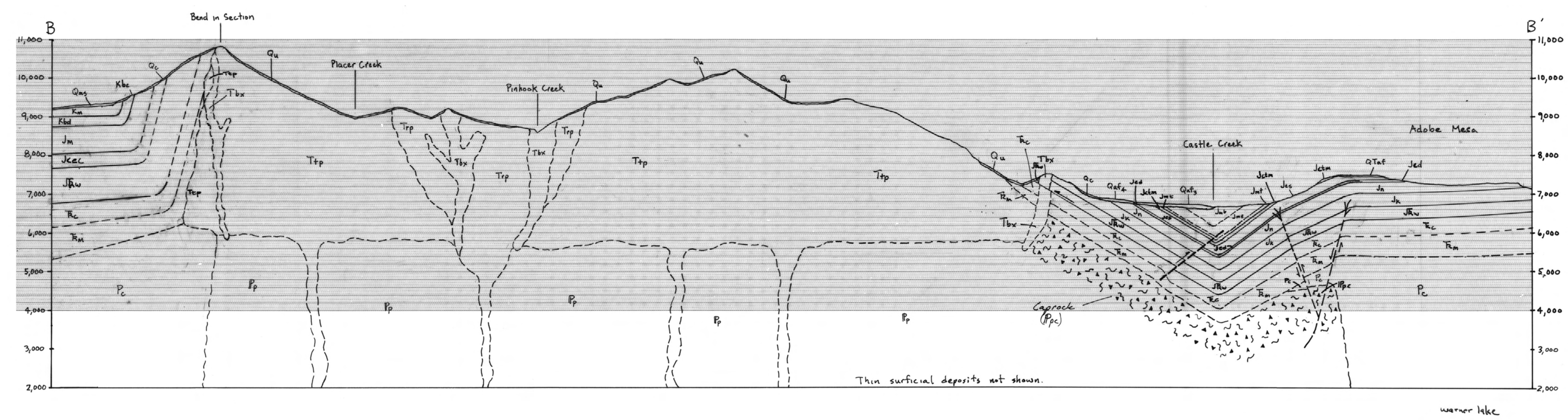
by

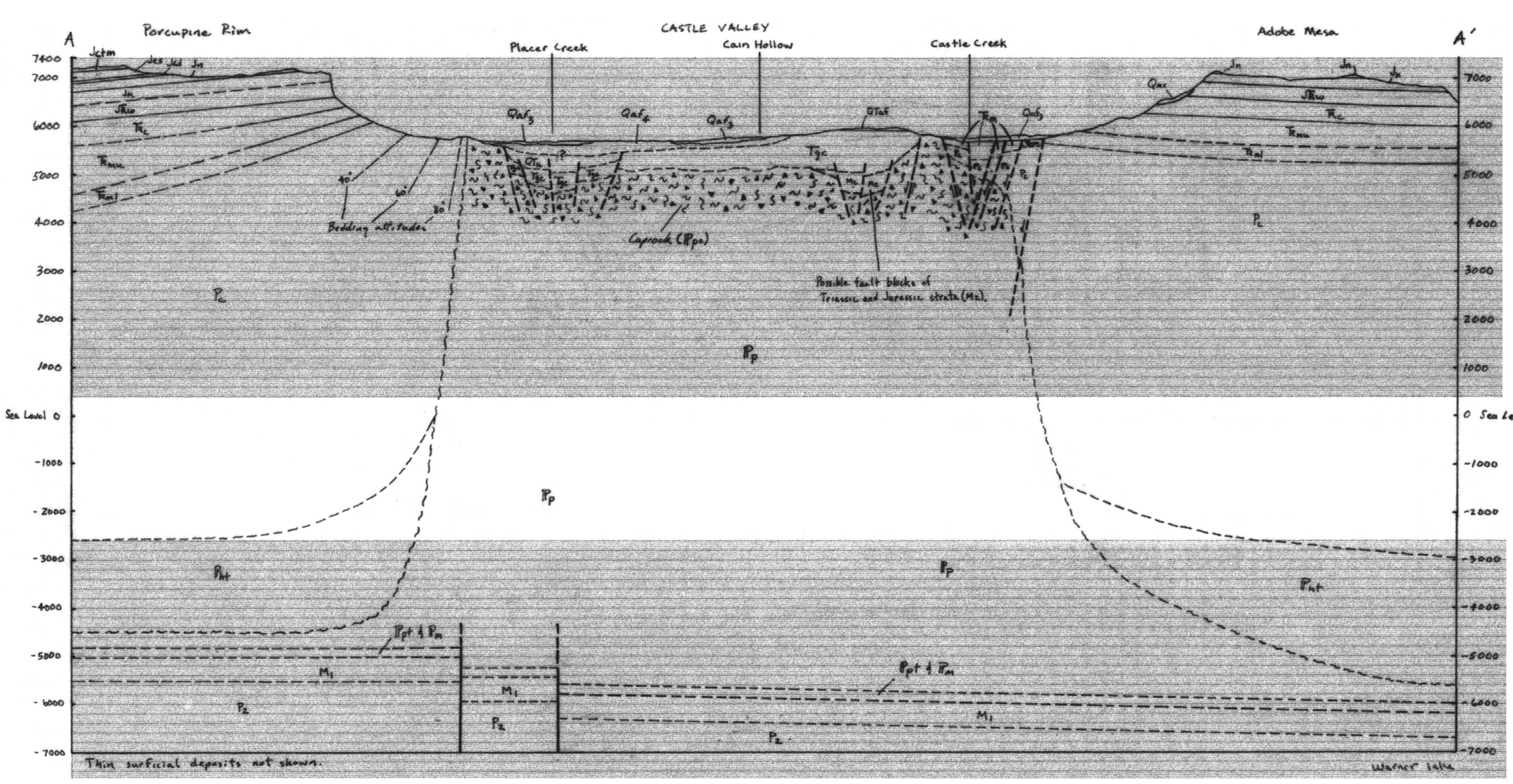
Michael L. Ross[1]

[1]Utah Geological Survey during period of mapping; now with ERM, Inc, Houston, Texas

ADJOINING 7.5' QUADRANGLE NAMES


C
C″
Warner Lake quadrangle
Mt. Waas quadrangle
C′
Tornado Basin
Mineral Mountain
Bachelor Basin
Castle Mountain
La Sal Peak
Little Bear Ridge
Bear Creek Bench
North Beaver Mesa
Sea Level


B
B′
Bend in Section
Placer Creek
Pinhook Creek
Castle Creek
Adobe Mesa
Caprock
Thin surficial deposits not shown.
Warner lake


A
A′
Porcupine Rim
CASTLE VALLEY
Placer Creek
Cain Hollow
Castle Creek
Adobe Mesa
Bedding attitudes
Caprock
Possible fault blocks of Triassic and Jurassic strata
Sea Level
Thin surficial deposits not shown.
Warner lake

PRELIMINARY GEOLOGIC MAP OF THE MOUNT WAAS QUADRANGLE, GRAND COUNTY, UTAH

by

Michael L. Ross

OPEN-FILE REPORT 496

UTAH GEOLOGICAL SURVEY

a division of

Utah Department of Natural Resources

2006

DESCRIPTION OF MAP UNITS

The description of map units is for both Mount Waas and Warner Lake quadrangles. Many units map are common to both quadrangles; however, some map units may only be found on one quadrangle.

UNDIFFERENTIATED DEPOSITS

Qu

UNDIFFFERENTIATED SURFICIAL DEPOSITS (QUATERNARY) – Shown on cross section only.

ALLUVIAL DEPOSITS

Qa_1
Qa_2

ALLUVIUM (HOLOCENE) – Poorly sorted sand, pebbles, silt, and clay; sand is unstratified to cross-bedded; pebbles are subangular to rounded; forms lenses and cut-and-fill features; younger alluvium (Qa_l) are preserved in low terraces and bars in the large active channels; Older alluvium (Qa_2) are preserved in slightly higher terraces along the flood plain above the entrenched channel; both deposits are characterized by weak soil development; Qa_1 deposits are less than 10 feet (3 m) thick and Qa_2 deposits are less than 30 feet (10 m) thick.

Qaf_3
Qaf_4
Qaf_5

ALLUVIAL-FAN DEPOSITS (PLEISTOCENE) – Poorly sorted, crudely bedded, muddy to sandy, cobble gravel with boulders in proximal fans; large clasts are subangular to rounded; includes lenses and cut-and-fill features and displays sheet-, fan-, and apron-shaped morphologies; younger deposits (Qaf_3) have dissected stoney surfaces characterized by stage I-II calcic soils and are 3 to 50 feet (1-15 m) thick. Intermediate age deposits (Qaf_4) are preserved in subtle ridges and dissected higher surfaces characterized by stage II-III calcic soils and are 6 to 120 feet (2-36 m) thick. Older deposits (Qaf_5) cap low hills in which no calcic soils have been found and are 3 to 40 feet (1-12 m) thick.

COLLUVIAL DEPOSITS

Qc

COLLUVIUM (HOLOCENE) – poorly sorted, blocky rock fragments (pebble to boulder size) mixed with interstitial sand, silt, clay, and commonly organic-rich soil; typically an unstratified mantle covering slopes; generally supports dense vegetation; 1 to 20 feet (0.3-6 m) thick.

EOLIAN DEPOSITS

Qes **EOLIAN DEPOSITS** (HOLOCENE) – Generally well-sorted, fine- to medium-grained, quartzose sand; typically forms thin though locally discontinuous blanket deposits; less than 10 feet (3 m) thick.

GLACIAL DEPOSITS

Qg **GLACIAL TILL** (PLEISTOCENE) – Unsorted and unstratified mixture of clay to blocky boulders; located only in Miners Basin; lateral moraine is about 140 feet (42 m) higher than adjacent ground moraine; thickness unknown.

MASS-MOVEMENT DEPOSITS

Qmt **TALUS** (HOLOCENE AND PLEISTOCENE) – Poorly sorted, angular to subangular boulders, cobbles, and pebbles, locally containing fine-grained matrix; forms cone- or sheet-like deposits at the base of cliffs; less than 20 feet (6 m) thick.

Qmbs Qmbl Qmbt **BLOCK-RUBBLE DEPOSITS** (HOLOCENE AND PLEISTOCENE) – Unsorted, randomly oriented, angular boulder- and cobble-sized blocks and slabs with fine-grained matrix; locally have crude fabric; generally lack soil development and large vegetation; sheet-like deposits (Qmbs) mantle slopes; other deposits (Qmbl) are large tabular or tongue-shape accumulations or are downslope in gullies (Qmbt); an estimated 3 to 40 feet (1-12 m) thick, but may locally be much thicker.

Qmr **ROCK GLACIERS** (HOLOCENE AND PLEISTOCENE) – Unsorted and randomly oriented angular blocks and slabs, with or without interstitial fines; form lobate bodies with steep downslope fronts that typically have arcuate ridges and furrows parallel to fronts; located only at elevations above 10,000 feet (3,000 m); estimated 10 to 40 feet (3-12 m) thick.

Qma **AVALANCHE/DEBRIS CONES** (HOLOCENE AND PLEISTOCENE) – Unsorted, angular boulders and cobbles mixed with interstitial fine-grained detritus; commonly contain abundant tree and soil debris; form slightly elongated cone- or fan-shaped deposits at the bottom of steep ravines; 10 to 100 feet (3-30 m) thick

Qmsy Qms Qmso **LANDSLIDE DEPOSITS** (HOLOCENE AND PLEISTOCENE) – Unsorted mixture of bedrock blocks and unconsolidated material of various sizes; deposits typically have hummocky topography; bedrock blocks have random or chaotic orientation; youngest landslides (Qmsy) have sharply defined easily recognizable geomorphic features; younger landslides (Qms) have slightly subdued but recognizable geomorphic features and are located on (reactivated parts of) relatively older landslides; older landslides (Qmso) have strongly degraded geomorphic features due to erosion; thickness is highly variable.

MIXED ENVIRONMENT DEPOSITS

Qec
Qce

MIXED COLLUVIUM AND EOLIAN DEPOSITS (HOLOCENE AND PLEISTOCENE) – Poorly to well-sorted mixtures of sand, silt, pebbles, clay, cobbles, and locally boulders; larger clasts are common in higher relief areas; forms blankets, discontinuous thin sheets, and lenses in ephemeral washes; largely weathered residuum reworked by eolian and colluvial processes; distinction between deposits based on dominant process; less than 20 feet (6 m) thick.

Qac

MIXED ALLUVIUM AND COLLUVIUM (HOLOCENE AND PLEISTOCENE) – Poorly sorted, crudely stratified, sandy, cobble gravel containing a large percentage of subangular cobbles and boulders; clasts vary from subrounded to angular; typically found along narrow ephemeral washes that have steep adjacent slopes where colluvium collects; reworked and transported by alluvial processes in the active channels; less than 15 feet (5 m) thick.

Qaco

OLDER MIXED ALLUVIUM AND COLLUVIUM (PLEISTOCENE) – Older deposits compositionally the same as Qac deposits but older relative age, based on geomorphic features visible on aerial photographs; less than 15 feet (5 m) thick.

OLDER SURFICIAL DEPOSITS

QTaf

OLDER ALLUVIAL-FAN DEPOSITS (PLEISTOCENE AND PLIOCENE) – Poorly sorted, crudely stratified, sandy, cobble gravel, and lesser poorly sorted, muddy sand, or boulders; gravel beds are mainly clast-supported; basal beds of thick deposits at Harpole Mesa are moderately indurated with calcium carbonate and mud; dissected lenses and sheet-like features; 6 to 250 feet (2-76 m) thick.

Tgc

GEYSER CREEK FANGLOMERATE (PLIOCENE) – Yellow-gray, pink-gray, and very pale orange conglomeratic sandstone, conglomerate, and sandy mudstone; basal beds are gray-red and red-brown, mostly poorly sorted pebbles and lesser cobbles in a fine- to coarse-grained arkosic sand matrix; larger clasts are primarily subangular to rounded igneous rock fragments; forms rounded ledges and steep slopes; conglomerate beds are thickly to massively bedded, sandy mudstone beds are thinner bedded; estimated 2000-plus feet (600+ m) thick.

IGNEOUS ROCKS OF NORTHERN LA SAL MOUNTAINS

Igneous rocks of the northern La Sal Mountains form shallow intrusions of various shapes, including: laccoliths, sills, dikes, plugs, and pipe-like bodies. The igneous rocks are holocrystalline, leucocratic, and porphyritic with an aphanitic groundmass. The porphyritic-aphanitic texture of the rocks resembles crystal-rich lavas in appearance rather than phaneritic plutonic rocks. Following the igneous rock classification and nomenclature in LeMaitre (1989), the rocks of the northern La Sal Mountains are trachyte, rhyolite, and phonolite (figure 1-4) using the Total Alkali-Silica Classification (TAS) of LeBas and others (1986). Field relations, petrography, and geochemical data allow the rocks to be further subdivided into the following lithologic map units: plagioclase trachyte porphyry (Ttp), peralkaline trachyte porphyry (Tpt), peralkaline rhyolite porphyry (Trp), and nosean phonolite porphyry (Tnp). An additional "igneous-related" rock unit is breccia (Tbx). Only plagioclase trachyte porphyry, rhyolite porphyry, and breccia are present in the Warner Lake quadrangle part of the northern La Sal Mountains igneous center. Based on $^{40}Ar/^{39}Ar$, K/Ar, and fission-track geochronology, magmatic activity in the northern La Sal Mountains occurred at 27.9 Ma, and activity at the remaining La Sal intrusive centers may have lasted until 25.1 Ma (Nelson and others, 1992a; 1992b). This timing is contemporaneous with magmatic activity in the Henry and Abajo Mountains (Nelson and others, 1992b).

Th

HORNFELS (OLIGOCENE) – Fine-grained, dense rock having variable coloration; formed by contact metamorphism during emplacement of igneous intrusive rocks.

Tnp

NOSEAN PHONOLITE PORPHYRY (OLIGOCENE) – Intrusive dikes containing phenocrysts of conspicuous large white plagioclase and K-feldspar, 0.8 to 2.4 inches (2-6 cm) and medium-to fine-grained feldspar, aegirine-augite, aegirine, nosean, and melanite garnet in a greenish gray microcrystalline trachytic groundmass of feldspar, aegirine-augite, magnetite, and biotite; forms blocky outcrops that weather greenish gray; locally contains xenoliths of plagioclase trachyte porphyry.

Trp

RHYOLITE PORPHYRY (OLOGOCENE) – Intrusion containing bimodal-sized euhedral plagioclase phenocrysts, 0.04 to 0.19 inch and 0.19 to 0.79 inch (1-5 mm and 5 mm-2 cm), and anhedral quartz phenocrysts, less than 0.19 inch (5 mm), in a microcrystalline groundmass of mainly feldspar and quartz; fresh surfaces are light-gray with yellow-brown patches; forms blocky outcrops that weather light-gray to tan with dark-brown patchy weathering-rind; locally vuggy.

Tbx

BRECCIA (OLIGOCENE) – White, gray, or red-brown angular rock fragments in a pale to dark-yellow-orange matrix; fragments are plagioclase trachyte porphyry, rhyolite porphyry, and/or sedimentary rocks; rock fragments are inches to 10 feet (tens of mm-3 m) in diameter; clast- to matrix-supported; the matrix is fine- to medium-grained and mainly crystalline carbonate with lesser amounts of quartz and opaque minerals; forms pipe- or dike-like bodies.

Tpt **PERALKALINE TRACHYTE PORPHYRY** (OLIGOCENE) – Intrusions containing large euhedral to subhedral phenocryts of gray plagioclase, microperthite, and K-feldspar, 0.2 to 1.2 inches (0.5-3 cm), smaller aegirine-augite, and hornblende in a light gray microcrystalline groundmass; groundmass consists of feldspar, aegirine-augite, biotite, hornblende, and magnetite; forms blocky to slabby outcrops at Mineral Mountain that weather to grayish brown to yellowish brown; exhibits conspicuous protoclastic (?) and filter-pressing textures.

Ttp **PLAGIOCLASE TRACHYTE PORPHYRY** (OLIGOCENE) – Dominant igneous rock of northern La Sal Mountains; intrusion containing euhedral white-gray plagioclase and black hornblende, and lesser black clinopyroxene phenocrysts, 0.04 to 0.31 inch (1-8 mm), in a light-gray microcrystalline, feldspar-rich groundmass; locally clinopyroxene is the dominant mafic mineral; also locally contains conspicuous hornblende-rich mafic inclusions; fresh surfaces are gray, speckled with white and black minerals giving a salt-and-pepper appearance; forms blocky to slabby outcrops that weather light-gray to brown.

STRATIFIED UNITS

Km **MANCOS SHALE** (UPPER CRETACEOUS) – Medium- to dark-gray, calcareous, silty shale interbedded with sparse light-gray siltstone and coquina; thin-bedded; locally fossiliferous; forms slopes typically covered by surficial deposits and vegetation; lower 200 feet (60 m) or less of formation is preserved in quadrangle.

Kbd **DAKOTA SANDSTONE AND BURRO CANYON FORMATION** (UPPER AND LOWER CRETACEOUS) – Dakota Sandstone is mapped with underlying Burro Canyon Formation where these formations are poorly exposed and a contact between them could not be determined with confidence or where one of the two formations is too thin to map separately at this scale.

Kd **DAKOTA SANDSTONE** (UPPER CRETACEOUS) – Yellow-orange, gray-orange, or yellow-gray, fine- to coarse-grained sandstone and conglomeratic sandstone interbedded with gray, calcareous mudstone and black, carbonaceous shale; thinly to thickly bedded, lenticular-bedded, and cross-bedded; pebbles are multicolored chert, mudstone intraclasts, and quartz; calcareous and ferruginous cement; locally contains thin coal seams and fossilized plants; forms flaggy ledges and gentle slopes; 50 to 100 feet (15-30 m) thick.

Kbc **BURRO CANYON FORMATION** (LOWER CRETACEOUS) – Basal cliff-forming, yellow-gray, gray-orange, and yellow-brown, quartzose conglomeratic sandstone; medium-grained, poorly sorted; medium- to thick-bedded, lenticular bedded, and cross-bedded; pebbles are multicolored chert, quartz, and siltstone and micrite intraclasts; conspicuous white clay; distinct patchy calcareous, siliceous, and locally ferruginous cement; overlain by slope-forming, pale-green, gray-green, and pale-brown non-swelling mudstone; and upper cliff-forming quartzose conglomeratic sandstone similar to basal conglomerate; gray, thin-bedded limestone (micrite) is locally preserved; 100 to 140 feet (30-42 m) thick.

Jm

MORRISON FORMATION (UPPER JURASSIC) – Divided into Brushy Basin, Salt Wash, and Tidwell Members, which are mapped as separate units and described below; however, the Morrison is mapped as one unit where the members are too thin to map at this scale or are not recognized.

Jmb

BRUSHY BASIN MEMBER (UPPER JURASSIC) – Variegated, smectitic mudstone and claystone interbedded with lenses of conglomeratic sandstone, sandstone, and siltstone; mudstone and claystone beds are shades of gray and red, and have a popcorn-texture on weathered surfaces; conglomeratic sandstone contains distinct, multicolored, chert pebbles; fine- to coarse-grained; poorly sorted; cross-bedded; forms steep slopes with dispersed ledges; gradational contact with underlying Salt Wash Member; 350 feet (110 m) thick.

Jms

SALT WASH MEMBER (UPPER JURASSIC) – Gray-white or yellow-gray, ledge-forming, conglomeratic sandstone and sandstone interbedded with gray-red, pale red-brown, and green-gray, slope-forming mudstone and siltstone; locally contains gray, thin-bedded, silty, micritic limestone; basal and uppermost conglomeratic sandstone beds are the thickest and most laterally extensive; conglomeratic sandstone contains multicolored chert pebbles and intraclastic red mudstone and white claystone; basal sandstone scoured and filled as much as 10 feet (3 m) into underlying Tidwell Member; 200 to 350 feet (60-110 m) thick.

Jmt

TIDWELL MEMBER (UPPER JURASSIC) – Contains lower sandstone unit and upper siltstone and mudstone unit: lower unit is pale-red, red-brown, and dark-brown, fine- to medium-grained sandstone; thinly laminated to medium-bedded that forms platy-weathering thin ledges; lower unit is 3 to 10 feet (1-3 m) thick; upper unit is red-brown, calcareous, siltstone and mudstone interbedded with pale-red-brown to gray, silty limestone and fine-grained sandstone that form an earthy slope with discontinuous thin ledges; locally contains large-diameter (less than 1 foot [0.3 m]), white, chert concretions; upper unit is 25-35 feet (8-11 m) thick; member is 30 to 40 feet (9-12 m) thick in total.

Jcec

MOAB MEMBER OF CURTIS FORMATION, SLICKROCK MEMBER OF ENTRADA SANDSTONE, AND DEWEY BRIDGE MEMBER OF CARMEL FORMATION (UPPER AND MIDDLE JURASSIC) – These formations are mapped as one unit where the formations are too thin to map at this scale or are not recognized; the individual formations are described below.

Jctm

MOAB MEMBER OF CURTIS FORMATION (UPPER JURASSIC) – Gray-orange-pink to gray-pink, friable, quartzose sandstone; fine- to medium-grained, well sorted, and calcareous; forms massive-weathering fluted cliffs and bare-rock outcrops with conspicuous joints; distinct subhorizontal bedding surface marks the J-3 unconformity and base of member; 90 to 120 feet (27-36 m) thick.

Jes

SLICK ROCK MEMBER OF ENTRADA SANDSTONE (MIDDLE JURASSIC) – Pale-red-brown to orange-pink, quartzose sandstone; fine- to medium-grained; moderate- to well-sorted, calcareous; thick- to massive-bedded; alternating planar beds and sweeping tangential eolian cross-beds; forms smooth cliffs and bare-rock slopes; lower contact placed at the base of mature, quartzose eolian sandstone; 250 feet (76 m) thick.

Jcd

DEWEY BRIDGE MEMBER OF CARMEL FORMATION (MIDDLE JURASSIC) – Mottled red-brown, gray-red, and gray-orange, muddy siltstone and very fine to medium-grained sandstone; locally contains thin chert-pebble conglomerate lenses; calcareous and hematitic cement; beds are commonly convoluted and folded; basal contact is sharp erosion surface (J-2 unconformity) on which detrital chert clasts are widespread; forms irregular rounded ledges and rubbly slope; 40 to 60 feet (12-18 m) thick.

JTRgc

GLEN CANYON GROUP – (LOWER JURASSIC AND UPPER TRIASSIC) – Divided into Navajo, Kayenta, and Wingate Formations, which are mapped as separate units and described below; however, the Glen Canyon Group is mapped as one unit where the formations are too thin to map at this scale or are not recognized.

Jn

NAVAJO SANDSTONE (LOWER JURASSIC) – Light-gray, pale-orange, and moderate-red-orange quartzarenite; well sorted, fine-grained with laminae of medium-grained sand along cross-bed foresets; medium- to massive-bedded with distinctive large-scale eolian cross-beds; locally contains thin, gray, cherty, sandy, micritic limestone; forms smooth, massive cliffs and rounded bare-rock knolls; gradational contact with underlying Kayenta Formation; 200 to 300 feet (60-90 m) thick.

Jk

KAYENTA FORMATION (LOWER JURASSIC) – Reddish (red-brown and gray-red) interbedded sandstone, siltstone, intraformational pebble conglomerate, and calcareous mudstone; sandstone is very fine to medium-grained, moderate to well-sorted feldspathic to lithic arenite; lenticular beds; small-scale cross-beds common; siltstone and mudstone are laminated or structureless; intraformational pebble conglomerate is poorly sorted, calcareous and siliceous cemented; forms step-like ledgy cliffs and slopes; conspicuous orange-pink eolian sandstone bed forms massive ledge in uppermost part of unit; contact with underlying Wingate Sandstone is sharp and erosional in some places and gradational and interfingering in others; 200 to 320 feet (60-98 m) thick.

JTRw **WINGATE SANDSTONE** (LOWER JURASSIC AND UPPER TRIASSIC) – Gray-orange-pink, moderate-orange-pink, to pale red-brown, quartzose to subarkosic sandstone; very fine to fine-grained, generally well sorted, and calcareous; medium- to massive-bedded with horizontal bedding and large-scale eolian cross-bedding; forms massive cliffs that are typically streaked and stained dark brown or black by a veneer of desert varnish; 300 feet (90 m) thick.

TRc **CHINLE FORMATION** (UPPER TRIASSIC) – Informal upper and lower members recognized, but not mapped separately; upper member is interbedded, moderate-red-brown, pale-red, to gray-red, calcareous lenticular sandstone, muddy siltstone, lithic-pebble intraformational conglomerate (clast-supported), calcareous mudstone, and micritic limestone; sandstone is fine- to medium-grained sublitharenite, moderate- to well-sorted, thinly laminated to thick-bedded with small-scale cross-bedding; uppermost strata are distinct lenses and sheets of massive, light-brown, fine-grained sandstone interbedded with thinner layers of pale-red, muddy siltstone; lower member is gray-white to gray-orange-pink, quartzose, conglomeratic sandstone and variegated mottled siltstone; forms thin, discontinuous lenses at the base of the formation; formation typically forms steep slopes separated by discontinuous ledges and cliffs; 250 to 400 feet (76-120 m) thick, may be thicker in rim synclines.

TRm **MOENKOPI FORMATION** (MIDDLE[?] AND LOWER TRIASSIC) – Divided into informal upper and lower members, which are mapped as separate units and described below; however, the Moenkopi is mapped as one unit where the members are too thin to map at this scale or are not recognized.

TRmu **UPPER MEMBER OF MOENKOPI FORMATION** (MIDDLE[?] AND LOWER TRIASSIC) – Red-brown, slope-forming siltstone, mudstone, and shale interbedded with red-brown, ledge-forming, sandstone and conglomeratic sandstone; ripple marks and mud cracks are common; thinly laminated to thick-bedded; siltstone is micaceous, thin-bedded, and contains oscillation ripples; sandstone is generally fine- to medium-grained, poor- to well-sorted, cross-bedded, locally contains lenses of pebble conglomerate; forms mainly slopes separated by ledges; the basal contact is placed at bottom of darker red-brown strata just above the highest prominent lighter red-brown ledge in the lower member; 250 to 500 feet (76-150 m) thick, may be thicker in rim synclines.

TRml **LOWER MEMBER OF MOENKOPI FORMATION** (LOWER TRIASSIC) – Red-brown and lavender, micaceous sandstone and conglomeratic sandstone interbedded with red-brown silty sandstone, siltstone, and mudstone; small-scale cross-bedding, ripple marks, and mud cracks common; sandstone is generally fine-grained and moderately sorted; conglomerate includes sedimentary and igneous rocks; siltstones are thinly laminated to thick-bedded; conspicuous, white and contorted gypsum bed is typically near base; 200 to 300 feet (60-90 m) thick, may be thicker in rim synclines.

Pc **CUTLER FORMATION** (LOWER PERMIAN) – Purple-red and red-brown, subarkosic to arkosic fluvial fine- to medium-grained sandstone, conglomeratic sandstone, and conglomerate interbedded with lesser red-orange, subarkosic to quartzose eolian sandstone; contains sparse thin gray, dolomitic mudstone; all strata are micaceous, thin- to thick-bedded, mainly sandstone with individual beds varying from poor- to well-sorted; conglomerate beds and lenses contain granules to cobbles of metamorphic and granitoid clasts; cross-bedding and cut-and-fill features common; forms ledgy slopes and step-like escarpments; estimated exposed thickness less than 1800 feet (5,500 m), may be 0 to 5000+ feet (0-1500+ m) thick in the subsurface due to salt tectonics.

IPht **HONAKER TRAIL FORMATION** (UPPER PENNSYLVANIAN) – Subsurface; shown on cross section only; 0 to 2700-plus feet (0-820+ m) thick.

IPpc **CAPROCK OF PARADOX FORMATION** (MIDDLE PENNSYLVANIAN) – Gray-white, light-gray, and pale-yellow-gray sucrosic gypsum, gypsiferous mudstone, shale, sandy siltstone, and limey dolomite; complexly folded and contorted bedding; small fragments of shale, siltstone, and dolomite are scattered on surface of outcrop; caprock (IPpc) is the leached residue of underlying Castle Valley salt diapir; 700 to 800 feet (210-240 m) thick.

IPp **PARADOX FORMATION** (LOWER PENNSYLVANIAN) – Subsurface; shown on cross section only; interbedded evaporate, clastic, and carbonate rocks; evaporates include finely laminated halite, sylvite, carnallite, and anhydrite and may constitute as much as 85 percent of the formation; clastic and carbonate rocks are interbedded shale, siltstone, and dolomite and are grouped into "marker beds" (Hite, 1977); Paradox Formation (IPp) is core of salt diaper and may exceed 9000 feet (2700 m).

IPpt IPm **PINKERTON TRAIL and MOLAS FORMATIONS** (LOWER PENNSYLVANIAN) – Subsurface; shown on cross section only; 200 feet (60 m) thick.

Ml **LEADVILLE LIMESTONE** (LOWER MISSISSIPPIAN) – Subsurface; shown on cross section only; 400 to 500 feet (120-150 m) thick.

Pz **PALEOZOIC STRATA, UNDIFFERENTIATED** (CAMBRIAN - DEVONIAN) – Subsurface; shown on cross section only; approximately 1500 feet (460 m) thick.

PRECAMBRIAN ROCK

pC **IGNEOUS AND HIGH-GRADE METAMORPHIC ROCK** (PRECAMBRIAN) – Subsurface; shown on cross section only.

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Table. Names of selected large workings located in the Warner Lake quadrangle and the last reported or observed size and status. Named workings numbers correspond to circled numbers on located on plate 1.

Name of Working	Size and Status
A. Miners Basin	
1. Dillion adit	1200 feet (366 m) long, caved
2. Wheat upper adit	35 feet (11 m) long, caved
3. Wheat lower adit	120 feet (36 m) long, caved
B. Tornado Basin (main workings only)	
4. Tornado No. 1 adit	40 feet (12 m) long, caved
5. Tornado No. 2 incline	30 feet (9 m) long, caved
6. Indiana adit	60 feet (18 m) long, caved
7. Leland No. 1 adit	65 feet (19 m) long, caved
8. Leland No. 2 adit	80 feet (24 m) long, caved
C. Grand View Mountain	
9. Reno No. 1 adit(s)	unknown, caved
D. Wilson Mesa – Jimmy Keen Flat	
10. Valley View Mine	about 350 feet (107 m) long, with several cross-cuts, partly caved
E. Bald Mesa	
11. “Radio Towers shaft 1”	≥ 40 feet (≥ 12 m), caved
12. “Radio Towers shaft 2”	≥ 40 feet (≥ 12 m), caved
13. “Radio Towers adit”	unknown, caved

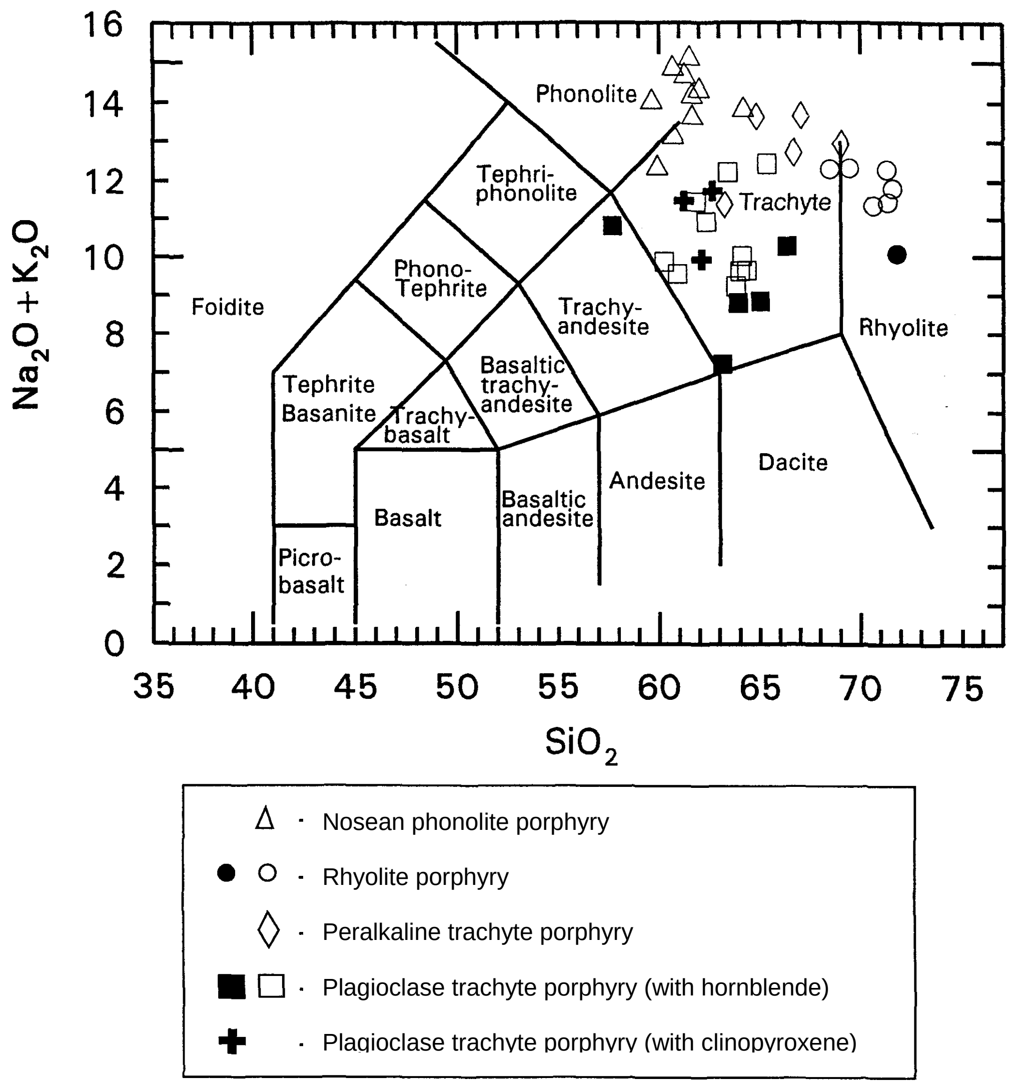


Figure 1. Total alkali-silica (TAS) classification diagram of porphyritic igneous rocks of the northern La Sal Mountains intrusive center. Closed symbols indicate samples from Warner Lake quadrangle. Open symbols indicate samples from Mt. Waas quadrangle.

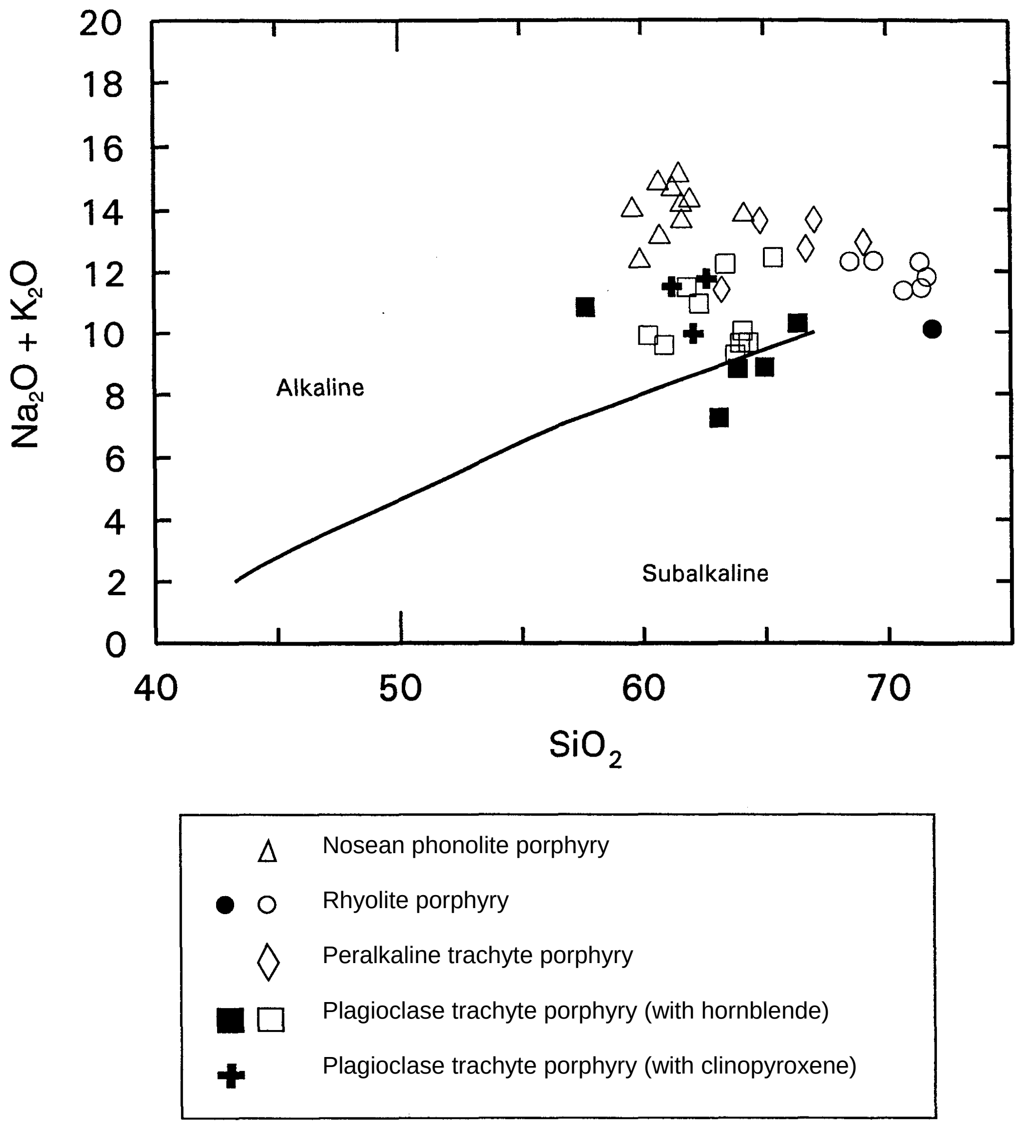


Figure 2. Alkaline/subalkaline diagram (after Irvine and Barager, 1971) of porphyritic igneous rock, of the northern La Sal Mountains intrusive center. Closed symbols for samples from the Warner Lake quadrangle. Open symbols for samples from the Mt. Waas quadrangle.

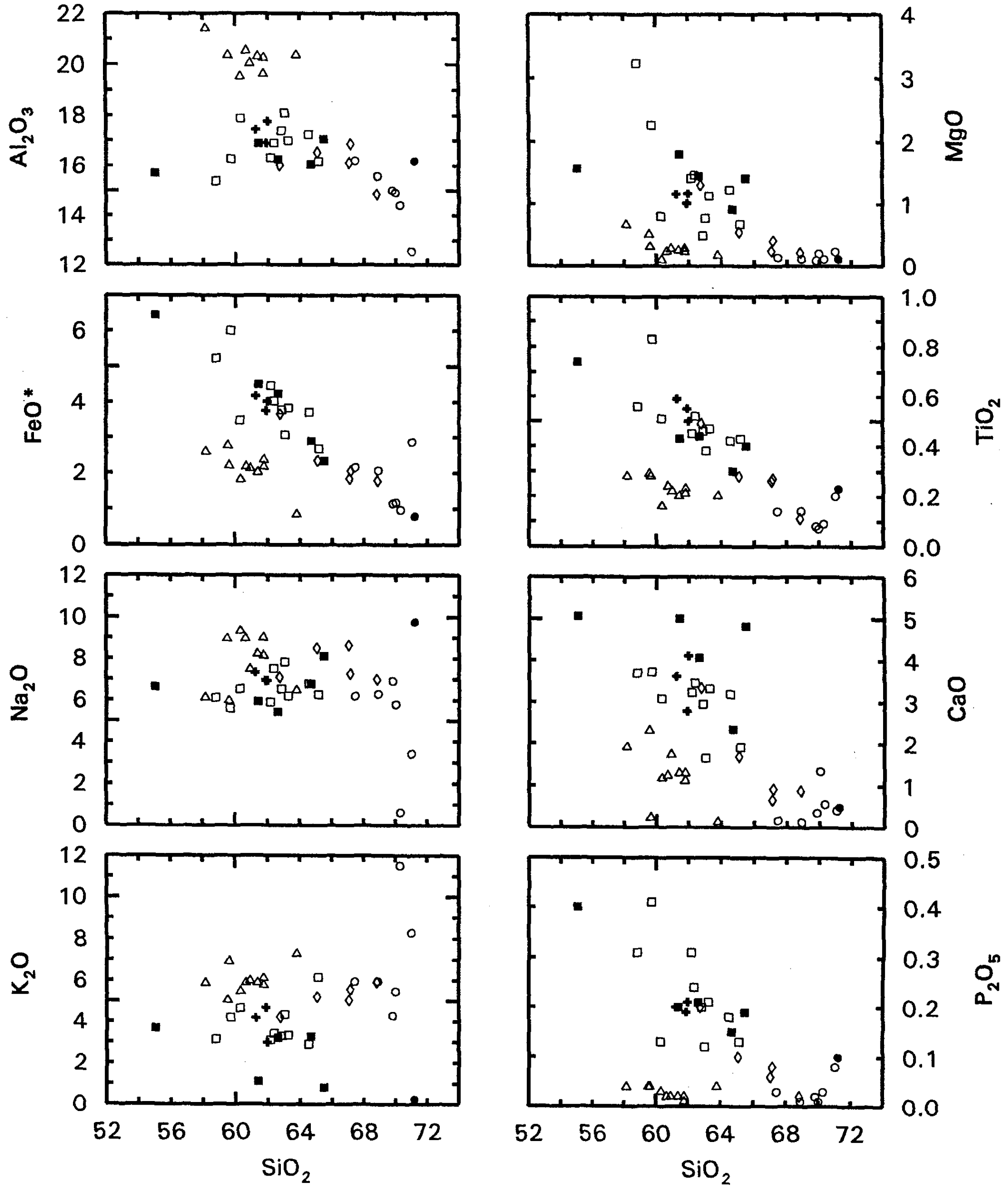
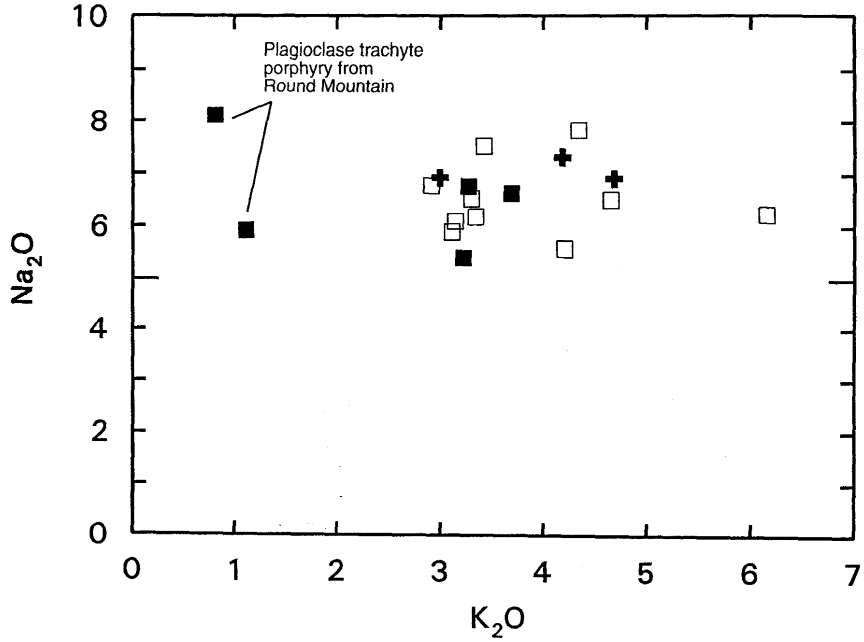


Figure 3. Harker variation diagrams of major elements of porphyritic igneous rocks of the northern La Sal Mountains intrusive center. Closed symbols for samples from the Warner Lake quadrangle. Open symbols for samples from the Mt. Waas quadrangle. Refer to figures 1 or 2 for symbol information.



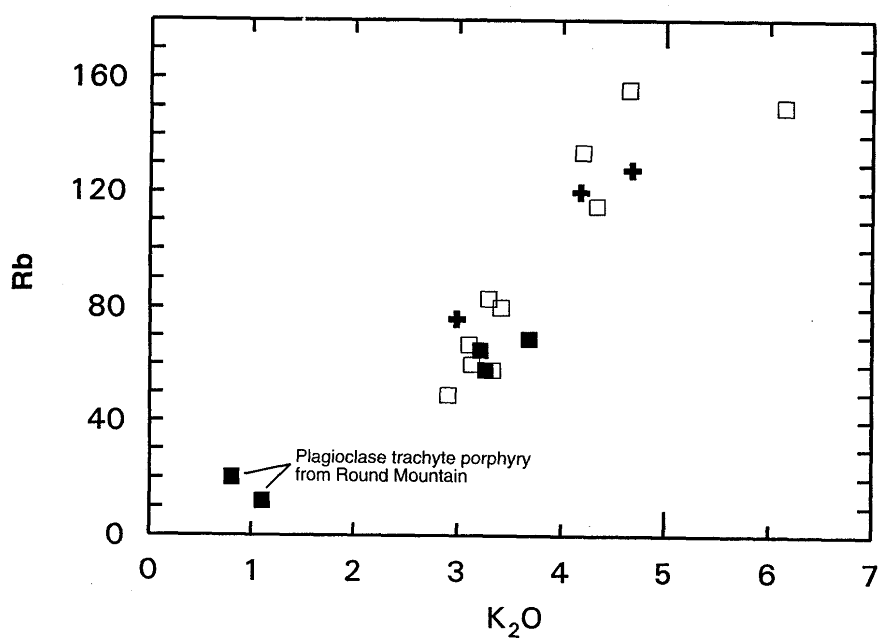
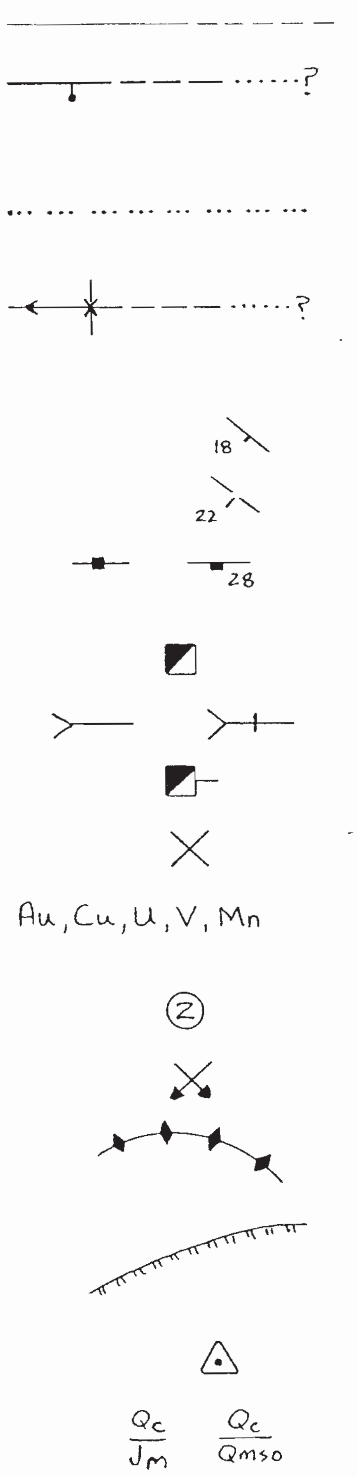


Figure 4. Variation in Na_2O (weight percent) and Rb (ppm) plotted verses K_2O (weight percent) for plagioclase trachyte porphyry of the northern La Sal Mountains intrusive center. Note the depletion of K_2O and Rb for the Round Mountain samples. Closed symbols for Warner Lake quadrangle samples. Open symbols for Mt. Waas quadrangle samples. See figure 1 for symbol information.

Map Symbols



Contact, dashed where approximately located

Fault, dashed where approximately located, dotted where covered, queried where uncertain; bar and ball on downthrown block

Fault(s), inferred fault zones along both sides of Castle Valley

Syncline, dashed where approximately located, dotted where covered, queried where uncertain; plunge of fold indicated

Strike and dip of bedding

Approximate strike and dip of bedding

Strike and dip of joints; vertical, inclined

Shaft

Adit; open, inaccessible

Incline

Prospect

Commodity -- gold, copper, uranium, vanadium, and manganese

Number by workings are those used in table 2

Gravel pit

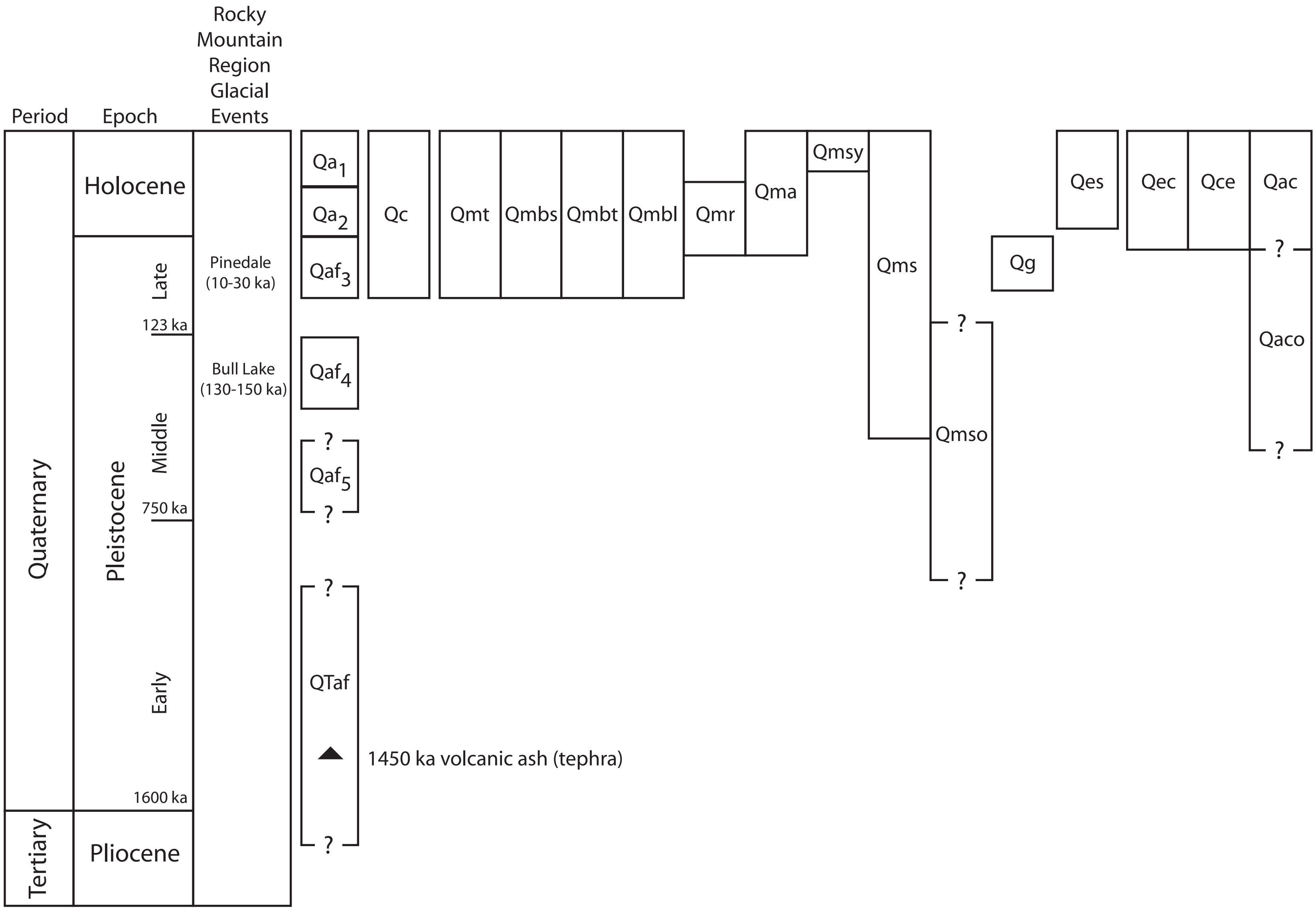
Ridge crest of lateral moraine

Landslide scarp

Volcanic ash (tephra) sample locality

Stacked map units -- indicates thin or discontinuous cover of one unit over another unit

Correlation of Surficial Map Units



Mount Waas (OFR 496) and Warner Lake (OFR 497) Quadrangles - 10/23/06

Correlation of Exposed Bedrock Map Units